CRANFIELD UNIVERSITY

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DELIVERING INNOVATION AND CHOICE IN WATER SUPPLY IN KENYA'S INFORMAL SETTLEMENTS

SCHOOL OF APPLIED SCIENCES
GLOBAL WATER POLICY AND MANAGEMENT

Msc THESIS by research
Academic Year: 2011 - 2012

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This thesis is submitted in partial fulfilment of the requirements for the degree of Master of Science by research

ABSTRACT

Improved access to water and sanitation in the worlds slums were among the key targets in the Millennium Development Goals. In Kenya, water is generally accessed in slum areas by filling 20l jerrycans at standposts and water kiosks and carrying back to households, with residents paying up to nine times more than utility bulk water prices and spending large parts of their day collecting water.

The aim of this research was to assess consumers' response and reaction to a series of water delivery mechanisms designed to offer a range of service levels and prices in accessing water in informal settlements. The current situation of residents' access to water in seven informal settlements in Nairobi and Kisumu was assessed via household surveys and interviews with water providers, both municipal utilities and private operators, supplemented with observation of local practises. A series of innovative water delivery techniques were then designed to suit the prevailing conditions intending to offer price differences and volumetric purchase options. Follow up surveys were then carried out.

This research has found that offering lower or alternative prices for water services in informal settlements is difficult due to challenges posed by vested interests and those interested in maintaining current high prices for water, and applying a difference in price was easiest in areas with already poor access to water or a new water kiosk. However, residents responded positively to the water delivery service, evidenced by a strong desire for this to continue and a willingness to assist operators in applying group purchases and volumetric purchases. Where it was possible to implement a difference in price corresponding to service level, consumers recognised their ability to move between service levels depending on variable income, their immediate demand and a simple choice.

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ACRONYMS

CBO	Community Based Organisation
DMM	Delegated Management Model
jc	Jerrycan
Kes	Kenyan shilling
KIAWASCO	Kisumu Water and Sewerage Company
NGO	Non-Governmental Organisation
NWSC	Nairobi Water and Sewerage Company
OWS	Obunga WATSAN
SSIP	Small Scale Independent Providers
UFW	Unaccounted for Water

NOTE ON CURRENCY

1 USD$ = Kes 84

Prices for water are given in Kenyan shillings. At the time of writing:

3Kes (cost of jerrycan in Kibera) = 3.6 USD$ cents

4Kes (cost of jerrycan in Kibera) = 4.8 USD$ cents

5Kes (cost of jerrycan in Kibera) = 6USD$ cents

The current ‘Lifeline block’ price for a conventional NWSC network connection delivers water at an equivalent price of 0.4 Kes per jerrycan (0.5 USD$ cents)

1 Introduction

For the first time in history, over half of the global population now live in urban areas (UNFPA, 2007), of which 1 billion live in 'urban slums', a figure that is projected to double by 2030 (UN-Habitat, 2003). This rapid growth in those living in slum areas leads to an increase in the number of, and those living in, informal settlements, presenting national and local authorities with massive challenges in the provision of basic services, including water and sanitation. Lack of access to clean safe water leads to people gaining water from unimproved sources such as wells and contaminated pipes, increasing the risk of contracting water borne diseases that are among the leading health risks in slums, such as dysentery and typhoid (Ali, 2010). The Millennium Development Goals seek to halve the number of people without access to safe drinking water and basic sanitation between 1990 and 2015. Though globally this target is deemed to be on track, unfortunately, most countries in Sub-Saharan Africa are not on target to achieve these goals (UN-Habitat, 2010).

Extending water supply services to the poor living in informal settlements in developing countries through conventional water utilities must overcome a number of potential challenges. The illegality of some slums and lack of secure tender hinders the provision of formal supply and dissuades residents from investing in formal connections. Settlements are often constructed on marginal land or land deemed unfit for conventional development, such as swamps, hillsides, desert, river banks and rubbish dumps (Davis, 2006). Technical challenges in extending services to such areas with conventional underground supply, and difficulties in planning for future growth, are compounded by the unplanned and often haphazard nature of settlements. Settlements are often very densely populated, and supplying residents with individual connections is further hindered when buildings are constructed in close proximity using waste and deleterious materials, or constructed in a non-robust fashion contravening standard building regulations. Within water utilities, poor operational and managerial performance, lack of technical expertise and corruption, lead to poorly maintained infrastructure, increasing water losses through leakages and

theft. The financial viability of utilities is compromised by unpaid bills, water theft and poorly designed tariff structures.

The lack of conventional individual connection-based, utility-led water supply to informal settlements through the operational, technical and financial challenges faced has spawned the growth of a variety of techniques for delivering and accessing water by a range of actors. Delivery though tankers, carts, wheelbarrows or private networks, collection at taps, tankers or wells using jerrycans, buckets, bottles and basins, provided by non-governmental organisations (NGOs) community based organisations (CBOs), residents, private operators and small scale independent providers (SSIPs), and utilities, means a substantial portion of the urban poor spend large parts of their day and significant portions of their limited incomes accessing their daily water requirement, with women and children contributing a disproportionately high level of time and energy.

This thesis describes research conducted to evaluate the impact of a series of pilot schemes designed to assess the scope for delivering innovation and choice in water access in low income areas. The aim of the research was to gain an insight in to the prevailing conditions regarding water supply and usage at the trial site, use this information to design the pilot schemes, apply the pilot schemes and assess the response and reaction of key actors.

A series of water delivery techniques deployed in informal settlements in Nairobi and Kisumu in Kenya, designed to give consumers an improvement in how they access and pay for water, are described in this thesis. The techniques were implemented with the assistance of a host NGO and CBO's selling utility supplied water, and constructed using primarily locally sourced and manufactured materials. The literature review provides an overview of the challenges faced by water utilities in serving low-

Figure 1: Map of Kenya

income urban consumers and suggested reforms and improvements. Following an outline of the research methodology and a background to water supply in the informal settlements, the individual pilot schemes are described, together with a description of the study locations including the current status of local water supply and use. The results of and responses to the trials are then described, followed by a discussion of the findings, and a conclusion.

2 Literature Review

Introduction

The literature review attempts to give an overview of the current state of population growth and accss to water in informal settlements in Sub-Saharan Africa and the reasons water utilities have failed to serve all urban populations with some suggestions for the reforms. It then describes some of the current techniques used by alternative suppliers indicating the potential and scope for innovations in water supply to be trialled with the goal of improving access to water and service levels in slums.

Sub-Saharan Africa is urbanising faster than any other area, with a further 300-700 million inhabitants expected by 2025 (WUP, 2003), and already has the lowest levels of water and sanitation coverage in the world at only 60% in 2000. Governments have not been able to match this rapid growth in population with the corresponding water and sanitation services required, and have not focussed on informal settlements for expanded water and sanitation coverage (Keener et al, 2010). Though the UN (2010) reports progress globally on the number of people with access to unimproved water sources falling to 783 million (9%), Bain et al (2012) and Onda et al (2012) both find that this figure is likely to be underestimated using the current monitoring criteria. Access to a safe, affordable and reliable water supply is essential for public health (Hunter et al, 2010) and contributes to poverty alleviation as well providing associated socio-economic benefits (Weitz and Franceys, 2002, UNESCO, 2007).

Failing utilities and suggested remedies

Though an inability or unwillingness to pay is sometimes identified as a risk by utilities when serving poorer customers (Danida 2006), numerous studies have shown that the poor pay more for water, for example in Kibera, Nairobi (Crow and Odaba, 2010, Brocklehurst et al, 2005, Birongo & Le, 2005). The lack of adequate keeping of customers' records, inefficient revenue collection (Mwanza, 2004, cited by Schwartz & Sanga, 2010), and ineffective pricing and

tariff pricing systems (Cross and Morel, 2005) lead to underperformance in utilities, resulting in inadequate maintenance, intermittent supply and poor financial health. Political interference and corruption (Cross and Morel, 2005) and a lack of a commercial or business orientated culture (Mugabi et al, 2007) compound the financial problems and prevent utilities from extending their services.

Franceys and Gerlach (2008, 2010, 2011) have written extensively on the need for appropriate and effective regulation of water and sanitation providers in extending services to the poor, and the need for consumer involvement in this regulation. The importance of involving the poor in decision making and the use of information, education and communication programs is noted by Weitz and Franceys (2002) and echoed by the World Bank WSP (2009). The use of delegated management models (DMM's), when not complemented by suitable regulation and consumer information programs 'has often led to a decline in service levels and increased prices' (Keener et al, 2010). The removal of technical and legal obstacles and a tackling of corruption are also essential in bolstering service providers in developing countries and extending services to the urban poor (WSP, 2006, 2009),

Lack of secure tenure or the illegality of settlements may also hinder water utilities intent on extending services to informal settlements. Households unsure of their legal status or rights may be unwilling to invest in immovable assets (Davis, 2006), or unwilling to fix water supply equipment to insecure or temporary structures. The construction of underground pipe networks may suggest a sense of permanence to illegal occupiers, something that local authorities and governments may be keen to avoid (WUP, 2003), in addition to the simple granting of tenure which can bring its own myriad of the potential problematic outcomes such as increased rents and land prices, or further growth of settlements (Dagdiveren & Robertson, 2009). Nevertheless, there are strategies that can circumvent land tenure issues such as: the laying of above ground pipes from a bulk meter at the edge of an informal area, and relying on residents to collect and revenue and settle bills (in Manila, reported by Tremolet

and Hunt, 2006, and Wateraid, 2009, a mini-version of which is used in this research); and using flexible above ground pipes connected to meter banks connected to the utility network (Jacobs & Franceys, 2011, a similar strategy is used in this research). WSP advocates the 'delinking of service provision to land tenure' and the application of suitable technologies in overcoming the diverse technical and physical challenges faced when supplying the equally diverse range of informal settlements (also Danida, 2006), which can be differentiated in terms of appropriate techniques and approaches to water supply (Bishop et al, 2011)

Households in informal settlements on limited incomes struggle to manage finances long term meaning the high initial investment in individual connections is often beyond them, excluding them from conventional supply (McIntosh, 2003, Franceys, 2005, Kayaga and Franceys 2007). In order for the MDG's to be met, and in order to provide low cost water and sanitation services, the creation of co-operatives to manage connections to groups of houses rather than individual connections is recommended by Mara and Alabaster (2008), where those unable to form or join co-operatives would be served by standpipes run by local communities groups. A subsidy for this high preliminary cost is proposed by Foster et al (2000) and the World Bank (WSP, 2009), and Manila Water Company increased coverage to 98% by allowing newly connected customers pay for the connection cost over a 1 to 3 year period (Wateraid, 2009). Whether individual or group connections, pro-poor financial strategies need to be adapted to ensure the poor are able to pay. Donkor (2010) highlights the fact that shared connections can result in those on limited incomes paying more for water when billed using increasing block tariffs, where domestic water consumption is billed depending on the pricing block in which consumption falls (Whittington et al, 2003). They may also contribute to the poor paying more for water though individual connections due to the negative correlation between poverty and household size, (Dahan and Nisan, 2007).

Cross and Morrell (2005) recommend the provision of a range of service options in how the poor access water reflecting their willingness to pay, as well as the

adoption of a variety of payment instruments to households who manage their finances daily, but struggle to do so in the long-term, echoed by the Water Utility Partnership (2003). Kayaga et al (2009) report on improvements made by the national water utility of Uganda in service coverage, number of connections and billing efficiency by using different measures such as prepaid meters, described by Laporte-Vergne (2010). Emphasis on hygiene, empowerment of consumers and overall access to water services are recommended by McGranahan (2002) in the adoption of demand-side strategies in supplying water to low income areas. Franceys and Gerlach (2008) see the need to understand a range of poverties in low-income areas that have to be considered when applying pro-poor financial and supply strategies.

Filling the Gap

A range of diverse water providers and supply techniques are used to fill the gap left by formal municipal utilities that have failed to extend conventional coverage to informal settlements. Water tankers, hand or animal drawn carts and wheel barrows for example are used to transport water to un-served areas. Privately operated boreholes may sell from standposts and water kiosks, also used to on-sell utility supplied water, which may also be sold by those with the financial means to afford individual connections. Community or group managed or operated taps or standposts, such as those in compound housing, are also used to supply groups of houses. 55% of the urban population in Sub Saharan Africa rely on standposts to collect water (Keener et al, 2010). Often referred to as Small Scale Independent Providers (SSIP's), the 'small' may be relative as they also extend to include privately owned piped networks (Schwartz and Sanga, 2010). A categorisation of SSIP's is provided by Kariuki and Schwartz (2005) and pictorial illustrations for a variety of supply and delivery options are supplied by Kayaga et al (2005), adaptations of which were used in this research.

The potential for overcharging, corruption and monopolistic behaviour are cited as key arguments against the promotion of SSIP's as alternative service providers by Franceys & Gerlach (2008), fears borne out by current practises in

Kibera, Nairobi (see below). Franceys and Gerlach (also World Bank, 2009) emphasise the requirement for regulation of SSIP's, though Dagdeviren and Robertson (2009) highlight the difficulties in this regulation, along with poor water quality and increased costs, as the primary concerns in the use of SSIP's. The relationship and contractual status between a SSIP controlling a privately owned network and the formal utility, who supplied bulk water, in Nyalenda, Kisumu, through a DMM, is described by Schwartz and Sanga (2010).

However, SSIP's play a very important role in supply water services to informal settlements. Their proximity to communities served allows the formation of closer relationships, and means they can respond to the needs and demands of consumers (Nijru, 2004). They may also be willing to make significant investment (Schaub Jones, 2008) though this investment may be limited as they can operate on a full cost recovery model (Solo, 1999), and these investment costs can be reduced through the use of innovative and appropriate technologies (Albu and Nijru, 2002).

Health effects

Poor quality water supplied by SSIP's is a key concern, particularly when water must be carried in vessels to the household. Chemuliti et al (2002), Alam (2007) and Kimani-Murage and Ngindu (2004) have documented a deterioration in water quality between point-of-source and point-of-use, and a greater emphasis on water treatment and quality at household level is recommended by Grundy et al (2004). But wherever people are not connected to conventional piped water supplies, "women bear a disproportionate share of the inconvenience, while infants and small children bear a disproportionate share of the burden of disease." (Kjellen & McGranahan, 2006).

Scope for innovation

The literature indicates that water utilities in many countries fail to supply low income areas with acceptable water services for a myriad of reasons, and that reforms and technological innovation are required to improve service levels,

such as using different distribution methods which have been trialled by both utilities and SSIP's. However, while the necessary reforms and pro-poor strategies are put in place there is scope for the offering consumers in informal settlements a service range in water supply with an equivalent range in price using innovative techniques, responding to their willingness and ability to pay, as suggested by Cross and Morrel (2005). Gerlach and Franceys (2010), allowing for acceptable compromises in service standards, suggest that services 'beyond standpipes' can be offered to extend service coverage to low income areas through a variety of technological options to extend the efficiency frontier (figure 2). The following research outlines a number of experiments in offering a choice in service level and price in informal settlements in Kenya.

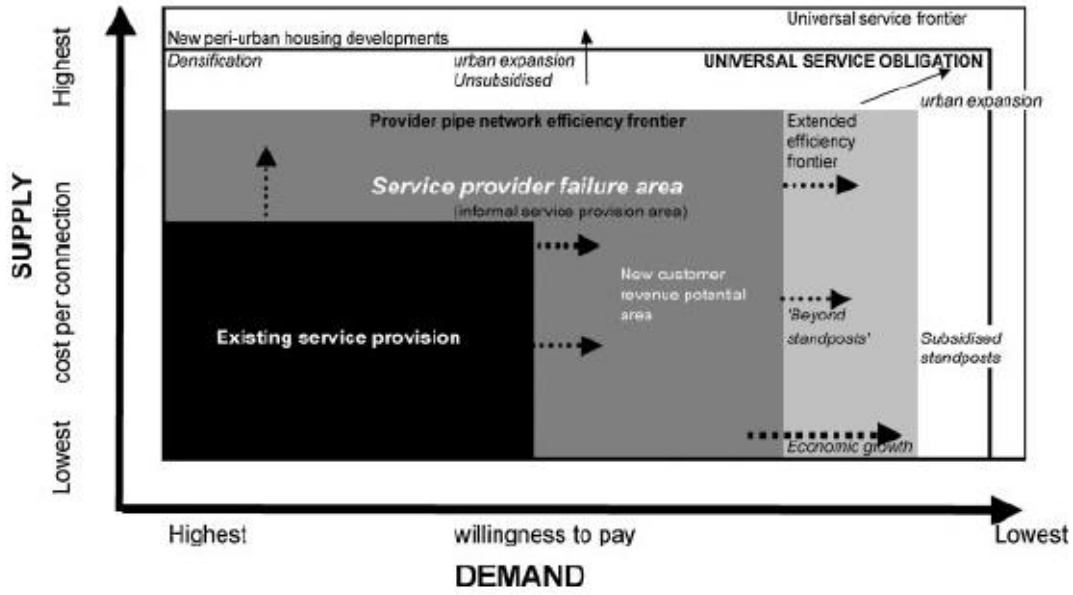


Figure 2: The boundaries of service provision, Gerlach and Franceys (2010)

3 Methodology

This research was carried out as part of a 'Water Choices' project funded by the Suez Environment – Water For All Foundation, in partnership with a Kenyan NGO, Umande Trust, based in Kenya, and Cranfield University. The project aimed to develop a 'demand driven' approach to water supply, creating a 'service ladder' to give customers a choice in the way they access water, with a corresponding difference in price (where possible) for different service levels,

ranging from standard collect-and-carry to variations in household delivery. Further innovations such as volumetric purchasing and household storage were also trialled.

The goal was for very low income consumers to be to be able to buy water by the bucket/jerrycan (as at present), buy by a daily filled household tank, buy by a metered household informal connection and possibly to buy by a prepaid meter and/or a volumetric controller. Along with the option of being able to swap between these alternatives as a household's situation allowed, all therefore 'changeable' as household income changed, with service quality able to go down as well as up, all choices being independent of landlords (due to the potential for increased rents if any structural changes were made to buildings) and any need for 'sunk' fixed assets as residents may be unwilling to invest in such assets due to insecurity of tenure (please see Appendix B for original Water Choices concepts and designs).

In addition to packaging individual innovations from many other countries into one service offer of choices, the research aimed that the service package should be enhanced through an 'aspirational design' approach so as to encourage demand for better quality water – in a manner analogous to the successful marketing of mobile phones in slums.

Seven sites were selected to trial the innovations using a variety of selection criteria. Trials were rolled out in settlements with different characteristics, from high density 'squatter' settlements, to less dense more dispersed peri-urban areas, and areas with different topographies and ground conditions. The host NGO also assisted in identify existing suitable water points with safe, clean reliable sources of utility piped water, and management groups who would assist in experimenting, elements required for the introduction of the Water Choices concept. The trials consisted in deploying a range of storage, delivery, metering and group metering options, and where delivery was an option, designed to replicate the health and convenience benefits associated with traditional household connections. The approach was designed to enable

consumers to move up and down the service ladder as incomes (dramatically variable for the poorest) and availability allowed. The majority of equipment and materials were sourced or fabricated in-country, so all materials can be purchased or repaired locally. Face to face household surveys before and after the rolling out of the trials were carried out using a questionnaire based on samples from Serving All Urban Consumers (WEDC, 2004) and previous surveys carried out by the host NGO were also used. This approach was considered the most appropriate in gaining an insight to current water practices, in particular quantitative data regarding amount consumed or time spent, rather than a more communal approach such as focus groups which proved more difficult to organise. Surveys were conducted by staff from the host NGO experienced in conducting social surveys and who were also briefed on the research goals and expectations. Subjects were queried regarding general water usage including quantity used, storage ability, extent of in-house water treatment and cost, difficulty and time spent in accessing water, as well as socio-economic factors such as house size and rent. Open ended questions were included at the end of the questionnaire (Robson, 2002) where subjects were encouraged to give their views on water supply in their area and any potential suggestions for improvement, and their response to the introduction of the pilots. The aim of the surveys was to generate quantitative and qualitative data in order to assess consumer responses. The researcher attended some of the interviews with individual surveyors to ensure surveys would be carried out correctly. The interviews were conducted in English where possible, or in Kiswahili or Luo with the aid of a translator. Approximately 30 households were surveyed around each trial site. In addition, a control group was also surveyed where no interventions were carried out to ensure external influence was not a factor in the individual trials, such as potential improvements to water supply due to upcoming national and local elections.

The managers and operators of the trial sites were interviewed before, during and after the application of the trials. The managers, operators and host NGO were key sources of information regarding overall water supply to the areas, such as reliability, and also in advising what potential innovations were more

likely to succeed in benefitting the surrounding community, and which innovations they were unwilling to trial. The financial data recording water transactions at each facility before and during the implementation were collected to evaluate any increase in sales. The layout, density and topography of the trial sites were also factors in what innovations, particularly in terms of delivery technique, were trialled, and their eventual suitability recorded.

In order to assist in assessing reaction and in developing and improving the trials as they progressed, spontaneous conversations with and feedback from consumers and operators were recorded on site, as recommended by Abrams (2010). Observation of consumer behaviour and practises, and the practises of the operators, were recorded before, during and after the application of the pilots and operators were assisted in project development and improvement in service delivery.

4 Background to Study Areas

Five of the seven experimental Water Choices Kiosks were constructed and tested in Nairobi, two in Kisumu in the west of Kenya.

4.1 Water Supply in Nairobi and Test Locations

Water and sewerage services in Nairobi are the responsibility of Nairobi Water and Sewerage Company (NWSC) which was devolved from Nairobi City Council in 2004, in response to the reform of Kenya's water sector in the Water Act (2002). Approximately 42% of households in Nairobi in 2005 had formal legal connections, with residents living in informal settlements (approximately 60% of the 3.2 million population) the majority of those without legal connections, accessing water through a variety of delivery services, illegal connections and water kiosks (Brocklehurst et al, 2005). Indeed, though NWSC estimated that the majority of residents had access to piped water, this was mainly through water kiosks (WSP, 2009), with unaccounted for water as high as 50%. NWSC set up a separate Informal Settlements Division within the company in 2008 to deal exclusively with water supply issues to these areas (NWSC, 2008). Trials were rolled out in 3 settlements in Nairobi: Kibera, Mukuru and Korogocho, where water is generally accessed by filling 20l jerrycans at water points and carrying back to households.

Bio-centres

The host NGO specialise in the construction of communal sanitation facilities, commonly called 'bio-centres', which, as well as providing toilet and shower facilities, also produce gas via an anaerobic digestion process using human waste. The bio-centres are generally run by CBO's. In most cases, bio-centres were used to trial the water choices concept.

Box 1: Note on bio-centres

4.1.1 Kibera

Kibera is one of the more notorious slums in the world, leading it to be one of the most studied, largely due to its 'fame as the largest slum in Africa' (Gerlach,

2006), though estimates of a population between 1 and 2 million have been shown to be somewhat overblown by a figure of 170,000 in a recent census (census cited by Chakava, 2010) and have caused some controversy (Karanja, 2010). Nevertheless, the settlement is densely populated and poorly served in terms of basic services such as water and sanitation and residents offered virtually no security of tenure as structures are officially unauthorised (Brockelhurst, 2005). The pilot schemes in this study were applied in Gatwekera village, which is characterised by a hilly topography and clusters and rows of mud houses forming access paths and small courtyards where residents congregate to perform domestic duties such as washing and cooking.

There are over 650 water kiosks supplying water in Kibera according to Brockelhurst (2005), operated primarily by private vendors connected to the NWSC network through both legal and illegal connections. Leakages, broken pipes and pipes sitting in open drains are a common sight, regularly damaged by pedestrian traffic.

Water supply in Kibera is largely controlled by a 'cartel' of water vendors who have been accused of working together and with NWSC and government officials to occasionally generate artificial shortages in order to increase prices, and frustrating progressive actions and attempts to improve overall supply in order to maintain their monopoly (Birongo & Le 2005). Concerns expressed by the vendors in response to reforms in Kenya's 2002 Water Act resulted in the formation of Maji Bora Kibera ("Better Water for Kibera, MBK), formed by vendors offering to standardise their connections in an attempt to secure regular supply from NWSC (Brockelhurst, 2005). However, after some initial success this relationship has gradually broken down (Crow and Odaba, 2010) and is now largely non-existent. Anecdotal evidence suggests that many water vendors are not averse to disconnecting or sabotaging the pipes of competitors or those trying to offer a different price. The cost of a 20l jerry can was increased universally from 3 to 4Kes in November 2011 and subsequently to 5Kes by June 2012. Consequently in Kibera, it is extremely difficult to offer a difference in price to correspond with a difference in service level due to the

possibility of reprisals. ‘Water Choices’ trials were undertaken at two facilities, Bidii Yeti, a standard water kiosk, and Jasho Letu, a bio-centre.

4.1.2 Mukuru

Mukuru is a slum located to the east of Nairobi city centre near the city’s industrial area, with a population of approximately 250,000. The area suffers from water shortages, and residents access water through standposts and kiosks connected legally and illegally to the NWSC network. Peal et al (2010) report on improvements made to water supply in the settlement through the installation of meter chambers with legalised connections to independent operators, who then sell to consumers. The project resulted in increased access to water for consumers, and increased revenues for NWSC.

Two trials were implemented in Mukuru-Kwa-Ruben village, a flat area meaning that after heavy rains access paths difficult and roads become difficult to pass as there is insufficient drainage. Most houses are constructed using corrugated sheet metal. Trials were implemented at TOP1, a two storey bio-centre with a neighbouring water kiosk, and Heshima, a single storey bio-centre beside which a kiosk was constructed.

4.1.3 Korogocho

Korogocho is a settlement situated to the west of Nairobi, compromising of 7 villages and located beside Nairobi’s largest dump, with a range of different topographies and housing layouts. Residents have no security of tenure. The area in which it was decided to construct a Water Choices Kiosk, High Ridge village, is characterised by wide access roads in a grid formation with densely packed mud and corrugated sheet-metal housing between roads. Residents generally collect and carry jerrycans from taps located on the access roads. The site in question was located near a school and a mosque with residents having to walk to a standpost some 100m away to access water.

4.2 Background to Water Supply in Kisumu and Test Locations

Water in Kisumu, Kenya's third largest city with a population of 425,000, is supplied by Kisumu Water and Sewerage Company (KIAWASCO), established in 2003 in response to the Water Act 2002. KIWASCO's service is characterised by high levels of unaccounted for water (UFW) at 67% and a low service coverage of 36% (WSP, 2009). Invariably, the 60% of Kisumu's population (UN-Habitat, 2005) that live in its informal settlements are those not fully covered by KIWASCO.

The utility has recently experimented with a 'Delegated Management Model' (DMM) in Nyalenda, the largest settlement in Kisumu, in partnership with Water and Sanitation Program Africa (WSP-Af) and Agence Francaise de Development. Under the DMM, water is sold via bulk meters to Master Operators who then on-sell this water at a fixed rate to consumers and sub-vendors. The delegated managers are responsible for the operation and maintenance of their network and are also contracted to extend this network at a monthly rate. Though there have been outstanding issues surrounding transferring existing customers, water services have improved in Nyalenda. Water losses have been reduced and the network has been expanded and improved (Schwartz & Sanga, 2010). Additionally, Nyalenda has also been the focus of trials using prepaid water meters, where individuals 'top-up' their meters at KIWASCO head office and then onsell to consumers. Though the prepaid meters had to be temporarily removed due to problems with remote IT servers preventing the meters being topped up, and replaced with standard meters, the utility intends to extend the project in Nyalenda and other areas (interview with KIWASCO technical manager).

4.2.1 Obunga

Obunga is a peri-urban settlement located near the industrial zone, and the area is characterised by clusters of predominantly mud and sheet metal houses separated by open grassed areas criss-crossed by open drains, piles of rubbish and unpaved paths. Water supply and networks in the area of study are owned

and operated by Obunga WATSAN (OWS), the master operators under the DMM model described above, in a partnership between KIWASCO and Sustainable Aid for Africa International (SANA). Water in the area of study is generally accessed through a series of water points and chambers, owned and operated by private vendors and sold at 3-5Kes/jerrycan, some delivered via flexible hosepipe or wheelbarrow. A water kiosk located near an existing bio-centre, and operated by the same management, was chosen to implement a trial in Obunga.

4.2.2 Bandani

Bandani is a further peri-urban settlement located on the outskirts of Kisumu that has not yet been taken over in a DMM. The settlement is quite poorly served in terms of water supply with many residents walking long distances from the few water points located in or around the settlement, as housing is quite dispersed. A newly constructed bio-centre was used as the focal point of the trial in this area.

5 Description of Individual Trials and Results

5.1 Bidii Yeti, Kibera

The Bidii water kiosk is located in the corner of a housing compound in a dense area of Gatwakera village, Kibera. The kiosk was originally suggested as a potential site for the Water choices project at the request of the project team and the host NGO, but also because the NGO had trialled a 'Maji Safi Mita Sitini' project (clean water at 60m') at the kiosk, in which water was delivered to households using a semi-flexible hosepipe. Though the project had met with some initial success, the service had been discontinued and the kiosk was non-operational for a number of reasons. The piped water network initially used to supply the 10,000l storage tank at the kiosk had been made redundant, and the nearest available pipe that could offer a potential supply only offered a supply for 2-4 days a week. More importantly however, a number of the members of the management group were themselves water vendors, some locally, and any innovations or attempts to improve the service delivery at the kiosk that might impact on the businesses were met with obstruction.

Despite repeated attempts to provide a catalyst to stimulate the managers in to reopening the kiosk with Water Choices elements, including renovating and re-painting the kiosk and providing a pump to enable the management group to fill the overhead storage tank, the influence of the vendors resulted in the group being disbanded and a subsequent group being formed to take over the management. At the time of writing the kiosk had just started to sell water via the traditional collecting and carrying of jerrycans, albeit only on a certain days of the week due to water supply issues. Due to the difficulties involved in simply selling water at the kiosk, Water Choices could not be implemented.

5.2 Jasho Letu, Kibera

Background

The host NGO requested that Water Choices be trialled at the Jasho Letu bio-centre, as the area is part of a long-term project of improved sanitation and drainage, urban greening and general improvement. Though the bio-centre originally had its own water connection to Nairobi Water Company, this had been disconnected some time ago (initially believed to be due to an unpaid bill, subsequently paid, but also due to sabotage by local vendors) and the centre relied on a local vendor to fill their 5,000l tank for a fee of 700Kes. Thus, the bio-centre obtained free water for showers and toilets, but all income generated from water sales were used to pay the vendor for filling the storage tank, ensuring the centre generated no profit from selling water, and making the hiring of an employee to distribute water via a delivery system problematical. The relaying of a new NWC supply was deemed too expensive (which would have included fees to a local 'group' for simply being allowed to carry out the work, and potential fees to vendors for laying pipework adjacent to theirs) and reconnecting the existing supply has proved difficult, as the original piped networks are now defunct.

The difficulties in supplying water in Kibera can be observed from attempts to supply water to the facility. The wife of the vendor who currently supplies the facility is on the management committee of the facility itself, meaning any discussions on a separate private supply were relayed directly to the vendor. The current chairman of the management committee is also a water vendor. In the intervening period, three new water points began to sell water near the bio-centre, meaning the delivery potential from the centre was reduced (see figure 2). The third of these was set up some 5m from the centre (by a vendor who had previously supplied the centre) and has started selling water at 2Kes/jc in an attempt to undercut the 5Kes/jc at the centre (The committee are confident that this third point will be removed due to 'vendor regulations' but have admitted that 'it's a fight'). However, the bio-centre is now selling very little water

via collect and carry due to the proximity of the nearby cheaper water source. (Also, it was discovered that an unknown connection had been made to the pipe supplying the bio-centre: the bio-centre supplier was being stolen from by another vendor).

Results

Despite the difficulties involved, an attempt to offer a choice was made by supplying 100l water storage tanks to some nearby houses that have been purchased by the management group with a loan from an American development bank, and having these filled weekly using a hosepipe from the bio-centre. The management group decided that, rather than collect separate fees for water, they would include a price for water in an increased rent (access to the sanitation and showering facilities, and garbage collection, are also included in an optional add-on to standard rent). A 210l storage tank that would normally cost 55Kes in jerrycans is sold once a week to tenants for 30Kes, who simply contact the bio-centre caretaker when their tank is empty and request a re-filling. These households would also have other vessels filled at this time for the standard 5Kes/jc (the bio-centre is temporarily manned by a nearby shop owner). Therefore, 8-10 tanks would be filled weekly, avoiding the requirement for a separate 'water employee'.

The tanks were also fitted with taps to allow owners to withdraw water without the use of bowls or scoops. Those that received tanks advised during interviews that they either used the storage tanks as 'treatment points' for drinking water, i.e. treating the water in the storage and using this water for drinking only; or used them simply for washing water and used smaller jerrycans for treating drinking water. Though the delivery service was very much appreciated by tenants, particularly the (cheaper) filling of the storage tanks, the high cost of filling other vessels is the major complaint, more so following the opening of the cheaper water point near the bio-centre. Thus, any residents who collect water now do so from the cheaper water point.

Figure 3: Jasho Letu Bio-centre showing location of surrounding water points and location of houses served by hosepipe

5.3 Heshima, Mukuru

Background

The Heshima bio-centre, run by a local disability group, is located in a difficult to access area in Mukuru-Ruben, the area being densely packed with narrow paths and access roads. The flat terrain means many of the open drains become channels of standing water and roads and streets becoming difficult to pass following heavy rains. The area also suffers from water shortages, poor pressure and illegal connections to the NWC network.

A new water kiosk was constructed adjacent to the existing single storey bio-centre (see Figure 3) with a 5,000l storage tank to guard against the prevailing water shortages and to supply adequate pressure for delivery through hosepipes (the storage tank was limited in size due to poor local ground conditions, the original bio-centre had originally been designed as a two storey structure). The kiosk took some time to build, as construction began just before the rainy season, making the supplying of materials the site extremely difficult.

The area is poorly served in terms of water supply, one of the reasons for applying Water Choices to this area. Though the existing bio-centre had an existing water connection, pressure was extremely variable in the mains and long lines of jerrycans were frequently observed waiting to be filled. The new storage tank ensured that jerrycans could be filled faster and also that there was adequate pressure for a delivery service from an external steel meter bank (locally made), which contains 4 standard water meters.

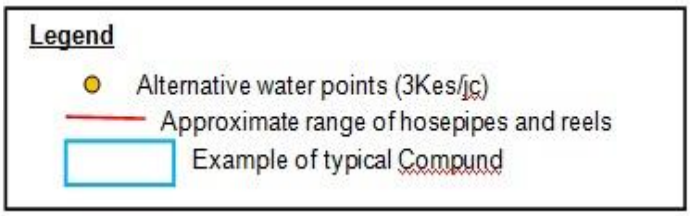
Figure 4: New Heshima Kiosk with storage tank, meter bank and connected hose-reels

A system was set up whereby the meter bank operator would connect a hosepipe and reel to one meter and roll out the device to a compound or entrance to a compound, from which the residents themselves would fill their own jerrycans and tanks. Once finished, the residents would call the operator who would return and collect revenues based on a reading of the meter at the kiosk. In the meantime, a further two or three hosepipes would have been rolled out and revenues collected using the same system. This allowed a number of compounds to be served simultaneously, with hosepipes of different lengths being used. The meter bank was broken in to on the first night after its completion, though only the door was stolen and this was swiftly replaced.

Results

Poor water pressure in the area resulted in the tank fully emptying from time to time, which was an annoyance to both the residents and the operator, who would have to scale down operations to two or sometimes one reel, reducing the potential coverage area. However, maximum sales were over 135 jerrycans when the tank was through 3 hose reels deployed simultaneously and the operator pointed out approximately 45 households that availed of the service. Daily records were kept by the operator by taking before and after meter readings and calculating daily sales, which were passed on to the bio-centre management. Records indicated that sales via collection would reduce on days the delivery service was in operation but would increase on Sundays when operator did not work due to church attendance.

Figure 5: Map of Heshima Bio-centre showing extent of delivery service



The primary benefits as advised by respondents were the positive effect on children from not having to collect as much water from the kiosk, and the saving of time and energy, leaving more time for commercial (running of shops and salons) and recreational activities (watching TV, praying, gossiping). Customers indicated they purchased more water when the hose-reel came to their door, and a majority of residents would also collect and carry some water from the kiosk, or alternatively walk to the nearest compound with a hosepipe and fill there. The bio-centre declined to reduce the price for collecting at the kiosk, so both services cost 3Kes/jc. When asked if they would like to see a difference in price for self service, a majority of respondents suggested that the prices should stay the same, fearing an increase rather than a reduction in price.

5.4 TOP1, Mukuru

Background

TOP1 consists of a two storey bio-centre and water kiosk containing two storage tanks totalling 11,000l of storage which is required to due poor and inconsistent water pressure in the area. Similarly to Heshima, a meter bank (see Figure 5) with a selection of hosepipes and hose reels of different lengths was constructed, and a delivery system centred on compound residents filling their own vessels and collecting revenues was applied. Difficulties arose when approximately 100m of the mains pipe feeding the kiosk had to be re-laid after being damaged by vehicular traffic during the rainy season, and after a further section of pipework was damaged and needed replacing shortly after commencement of the pilot. In addition, shortly after the completion of construction of the meter bank but prior to the commencement of the delivery and volumetric purchase system, local

Figure 6: Meter Bank at TOP1

residents and the managers of the bio-centre were served with notice that the land on which they live is to be sold after some ownership disputes. This contributed to a delay in beginning the project.

Results

As with Heshima, the operators of TOP1 declined to give a reduction in price for the standard collect and carry while maintaining the prevailing 5Kes/jc for the delivery service, thus customers paid the same for both services. Customers, when asked, in the main believed the price should remain the same, though the researcher believes this to be more a fear of the price increasing for delivery. Virtually all residents advised they purchased additional jerrycans via the hosepipe, and most also purchased one or two jerrycans at the water kiosk.

Figure 7: Plan of TOP1 showing extent of delivery service

Following the introduction of a pump to ensure the storage tanks were constantly full, pressure in the delivery pipes was not an issue. Residents however advised that the service needed to be marketed and advertised better as many were unaware of the ability to access to the service, though this may have been due to the group members preoccupation with their land tenancy issues. However once the project was implemented, records showed an overall increase in kiosk sales, but with a reduced revenue from the collect and carry mode.

5.5 High Ridge village, Korogocho

A site adjacent to a disused hospital compound in High Ridge village was originally proposed as a site for a Water Choices Kiosk. Residents in this area have to walk up to 100m to fill and collect jerrycans and initial discussions with local residents and the potential management group indicated they were willing to assist in trialling the project. Also, the former hospital compound contained a disused buried water network and the intention had been to renovate this network, enabling the kiosk to supply to a series of remote standposts and potentially individual household connections. Gaining permission to construct on this site necessitated lengthy discussions with the local chief and the owners of the plot. However, despite eventually gaining permission to build, this was withdrawn shortly after construction began after some local opposition from residents who requested free water, requiring a new site to be acquired and beginning the discussion and surveying phase once again.

Subsequently an alternative site was kindly donated by a local school some 250m away that could still be managed by the intended community group. The school agreed that the kiosk could be constructed on the site, with the school receiving a limited amount of free water from the kiosk for use by the children. The kiosk is to be equipped with a meter bank for use by surrounding housing compounds and potentially subsequent in-compound networks. However, due to the aborted construction, delays in acquiring the second site and construction delays, the kiosk was not operational at the time of writing.

5.6 Obunga Bio-Centre and William Otieno, Kisumu

Background

A non-operational water kiosk was selected as a proposed site to apply the Water Choices concept, as a 60m hosepipe had formerly been used to provide a delivery service from the kiosk. The hosepipe had also been connected to a tap in a concrete chamber located some 50m away which was connected to the kiosk via a buried pipe. The kiosk and chamber were not operating due to a combination of unpaid bills and broken pipework. The kiosk is located on the grounds of a nearby church, however the church agreed to allow the management committee of the newly constructed bio-centre (some of whose members are also church members) to take over the running of the kiosk. Therefore a new water connection was laid to the bio-centre with a metered tee connection to the kiosk and subsequent chamber (also separately metered), with the intention of again providing a delivery service with a hosepipe and reel with a volumetric purchase option, together with the collect and carry option from the kiosk.

William Otieno is a water vendor in Obunga who is also a member of the management committee of the local bio-centre. William had already been supplying water to houses in Obunga via a hosepipe from his own water connection in a ground level chamber and attempts were made to improve the service he provided by supplying him with additional equipment (see Figure 7). This included a lightweight reel fixed to the frame of a wheelbarrow, designed to his request, and a standard portable water meter to be used to give an option of a volumetric purchase at the household level. Thus, with both William's service and that provided from the kiosk and chamber, a large are of Obunga could be covered by the delivery services with the additional option of collecting from the kiosk for a reduced price, 3 Kes/jc, as opposed is 4Kes/jc for delivery.

Results

Figure 8: William Otieno's hose-reel

Despite the agreement between church and bio-centre, the church never allowed the bio-centre to take over the kiosk, and have since applied for their own connection intending to sell water separately. Thus, the bio-centre managers were only able to sell water via the hosepipe from the chamber and were unable to offer a difference in price or an additional service (collect and carry). The newly laid pipe required repeated repairs (it was assumed that a nearby plot owner was intentionally damaging the pipe) and had to eventually be re-laid. As William Otieno was the nearest operator to the bio-centre and a member of the bio-centre committee, it was agreed that the two services would not overlap.

However, with additional water points in the area, there was still an option for residents to collect and carry if they required or opted to, though the price per jerrycan was the same as the delivered option. Residents reported an appreciation for both delivery services with a majority obtaining all of their water needs via the hosepipe, and the remainder collecting one or two jerrycans from alternative sources if required, some suggesting a time saving of up to two hours. Residents generally purchased and carried a jerrycan when the delivery pipe was in a different are (or alternatively had one delivered via wheelbarrow, see, leading to the primary suggested improvement in the service of more delivery pipes.

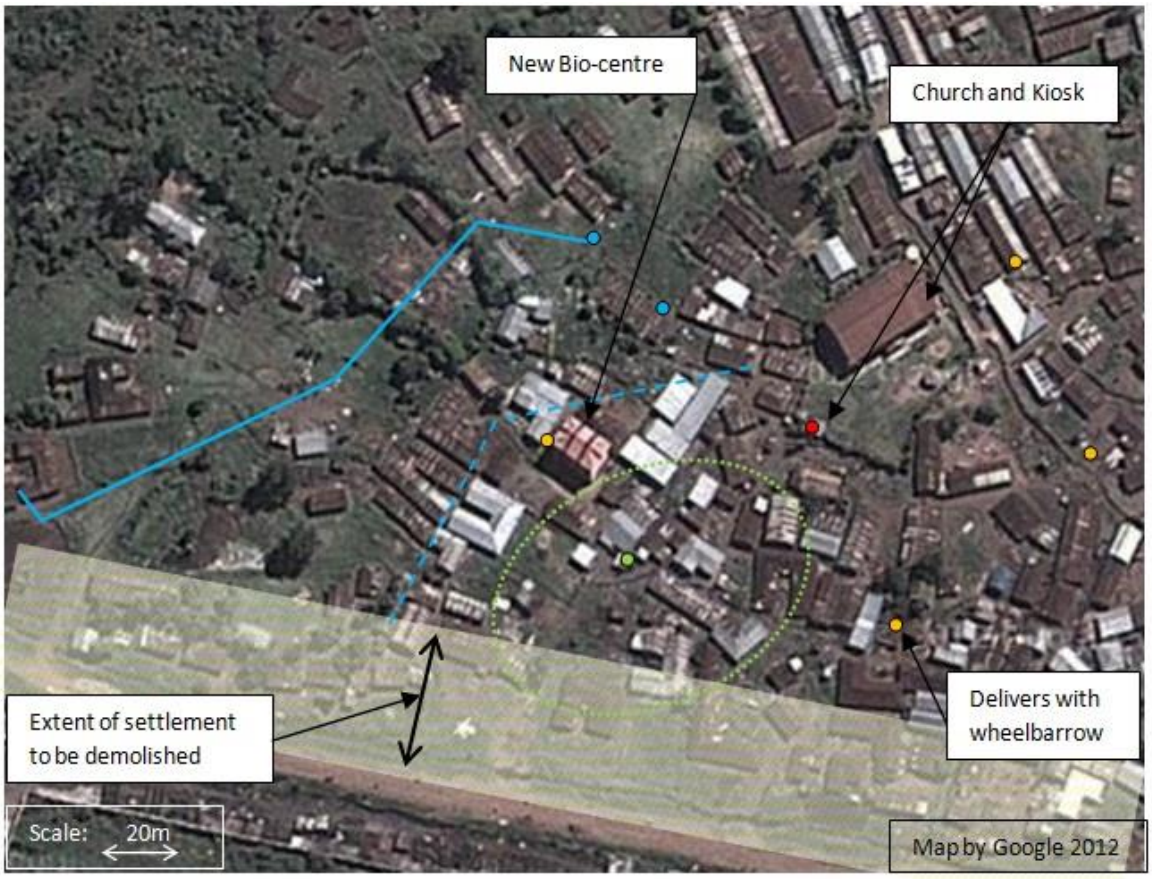


Figure 9: Map of Obunga showing extent of delivery services

The ability to simply move quicker with the equipment provided enabled William to as much as double his daily water sales from 50-75 jerrycans per day up to 150, simply as he was able to move between customers faster. William attributed the variation in sales (400-600Kes per day) to residents with storage tanks only purchasing 2 or 3 times weekly. The initial response to the handheld water meter was very positive, with customers able to fill alternative vessels such as buckets and pots, as well as in-house storage tanks. However, after a period of some months the meter was fixed to the chamber and was simply used to measure daily sales (this had to be replaced after a breakage in the supply network caused debris to break the meter). William explained that he tired of worrying whether the meter would be stolen but also because he knew,

and more importantly his customers knew, the cost of filling each vessel, even a partially filled in-house storage tank. The proximity of other vendors limited the service coverage area of the hose-reel fixed to the water chamber.

William explained that his revenues would drop considerably during the rainy seasons or after overnight rainstorms, as much as half, as residents harvested rainwater from roofs, which would generally be used for washing. Residents primarily purchased water in this instance for cooking and drinking. Additionally, the construction of a new bypass along the existing road bordering the settlement will shortly result in the demolition of a strip of houses beside the road. This has resulted in the removal of an initial source of business, fish meal sellers, who had initially been positioned beside the road and had enthusiastically received the initial delivery service but have since been moved due to the construction of a new bypass.

5.7 Bandani Bio-Centre, Kisumu

Background

A newly constructed bio-centre was used to trial Water Choices in Bandani. This entailed constructing a new water connection to the utility network, and the conversion of one of the rooms into a kiosk, with the replacement of a section of pitched roof with a new concrete slab. Water pressure in the local network varies, necessitating the provision of a storage tank to ensure an adequate pressure for supply through flexible hosepipes. Though the bio-centre had been earlier identified as a potential Water Choices site, it took some time to start the project in this area. Applying for, paying for and laying the new water connection (as well as repairing the inevitable leaks) took some months, a delay compounded by the non-payment of the initial water bill which resulted in disconnection, and a delay in re-connection. The bio-centre is managed by a local community group which have experienced some management difficulties and constructing the necessary structural elements and internal pipework took more time and more money than seemed reasonable.

Figure 10: Hosepipe for delivery with bio-centre and tank in the background

The settlement is more dispersed than highly dense settlements such as Kibera, with groups and compounds of houses located at varying distances from the water source, the closest to the kiosk being some 25m away. In order to apply a delivery service, this required the use of a single hose-reel as multiple reels would lead to inadequate pressure in the delivery pipes. The locally made hose reel was fixed to a wheelbarrow and equipped with 100m of hosepipe and moved from compound to compound and house to house, filling jerrycans and tanks. Additionally, a variation in price was offered for the different service level: 2Kes/jc for filling and collecting at the kiosk, 3Kes/jc for delivery through the hosepipe.

An attempt was also made to offer volumetric purchase options to individual compounds by supplying standard water meters in protected steel cages which were also made locally (the original concept had been to 'fix' the reels in the compounds but this was advised against as landlords may wish to increase rents due to the 'improved facilities', even though they had not contributed to these improvements). The operator of the hosepipe would fix a second pipe (connected directly to the mains connection, i.e. not the storage tank) to meters in compounds, allowing residents to obtain water as required. The operator would take meter readings at the start and end of supply and collect revenues accordingly (monies in the compound would be collected by a resident). However, this was not completed at the time of writing due to overall project delays, teaching residents in reading the meters and generation of initial trust between bio-centre managers and compound residents.

Results

The cheaper price for a jerrycan introduced at the new kiosk resulted in an immediate response from consumers, with up to 200 jerrycans being sold per day. In the 2 months prior to commencement of the delivery service sales at the kiosk averaged approximately 65/day, a level maintained once the hosepipe began to be rolled out. An additional average of 58 jerrycans per day were sold via the hosepipe or a total for 12 households at an average of 5 jerrycans daily consumption per household, with a maximum of 90 jerrycans per day, 18 households. However, given that over half of respondents still collected some water from the kiosk for reasons given above, on average 3 jerrycans per household, the total number of houses accessing water via the delivery service is higher, the operator indicting over 50 households to that had availed of the delivery service The kiosk maintained average sales of 65 jerrycans per day, with a maximum of 110.

Responses to the delivery option ranged from those who collected all their water from the kiosk as this was the cheaper option, to those who sometimes collected water as they were unable to wait for the delivery or who had insufficient funds and wanted to save money, to those with sufficient storage or number of jerrycans (and sufficient money) and waited for the service until it arrived, regardless of the additional cost.

The distance some residents had to travel to the kiosk was cited as one of the main reasons for waiting for the delivery service, as some customers would walk over 100m to and from the kiosk. Customers also seemed quite content to collect jerrycans occasionally: ‘ah, it’s only once, and I don’t want to wait.....and anyway, it’s cheaper.’ Elderly customers also benefitted as many had previously accessed water by paying vendors to deliver water via a wheelbarrow for as much as 10Kes/jc: also, these customers were also pleased with the service as they ‘know where the water comes from’, i.e. customers could not be sure if the wheelbarrow deliverers used a treated water source. Additional beneficiaries were users of large amounts of water such as a local

mini-brewery, shops and bars. Residents requested a Sunday delivery service as the operator did not work Sundays due to church attendance.

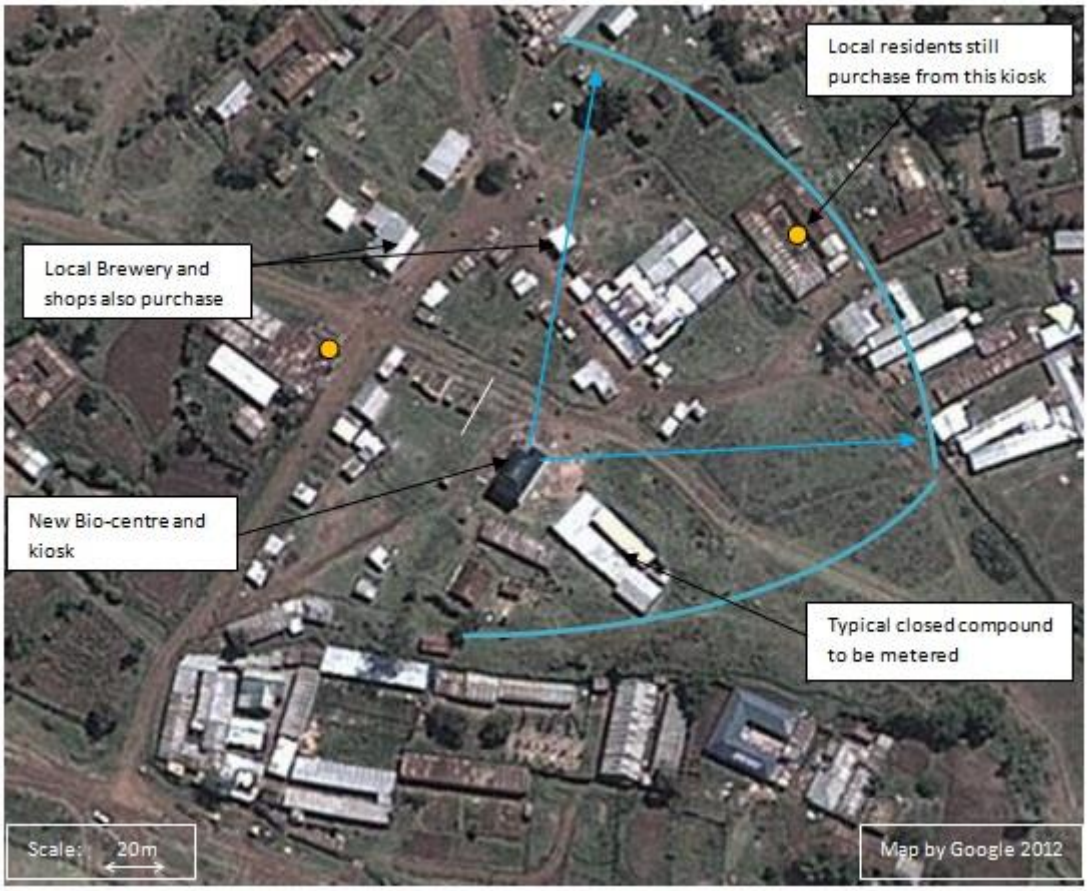


Figure 11: Map of Bandani showing extent of delivery service

5.8 Wimma Bio-centre, Mukuru – Control Group

The area surrounding a bio-centre currently under construction was used as the control group as the area is due to benefit from improved water supply upon completion of the facility, and residents had been surveyed by the host NGO prior to commencement of construction. Residents reported no improvement in access to water or in delivery services in follow up interviews.

6 Discussion

Effect on Water Kiosk Sales

Of the three kiosks at which a delivery service was implemented alongside the standard collect and carry mode, all reported an increase in overall sales once the delivery service was rolled out (Heshima, TOP1 and Bandani). Sales via collect and carry at these three kiosks were maintained or reduced as more customers accessed water via the delivery service (See Table 1). The increase in overall sales for the kiosk for Bandani is given for sales and number of jerrycans sold due to the difference in price for collect and carry and delivery. The number of jerrycans sold and households served on a daily basis varied due to low levels of water pressure and lower demand, for example after rainfall when households collected water, and maximum numbers are given. In some instances both services would be discontinued due to lack of water. The households availing of the delivery service were pointed out by operators on a walk through the areas served. The Obunga service was provided by two operators to a limited area of the settlement (see figure 8) with residents indicating they purchased an average of less than 1 jerrycan per household via collection at alternative water points.

The increase in kiosk sales is borne out by the increased number of jerrycans purchased at the household level (Table 2), with residents who availed of the delivery service indicating they purchased additional water. Time saved in collecting varied depending on proximity to water points, some residents indicating they saved up to 3 hours a day collecting water.

	Jasho Letu	Heshima	TOP1	Obunga	Bandani
Delivery Method	Single hosepipe to houses supplied with tank – houses owned by management	Multiple pipes from meter bank	Multiple pipes from meter bank	2 no pipes from separate chambers – 1 privately owned, 1 group managed	Single 100m hosepipe
Approximate population within radius of delivery[1]	2,100, 50m	1300[2], 60m	1300[2], 60m	2550, 100m & 50m	n/a, 100m
Jerrycan Price for Collection	5Kes	3Kes	5Kes	3Kes (Alternative supplier)	2Kes
Jerrycan Price for Delivery	5Kes - Price included in rent	3kes	5kes	4Kes (2 services)	3Kes
% Change in sales at Kiosk via collection	n/a	-40%	-23%	n/a	0%
% Increase in overall sales due to collection and delivery	N	+ 150%	+ 42%	n/a	+106% (+71% no of jerrycans)
Daily average number of jerrycans via delivery	n/a	48 (effected by low pressure)	23	160 approx (2 services)	58
Max no jerrycans by delivery in one day.	8 tanks per week – 40 jerrycans	135	n/a	219 (2 services)	90
Approximate number of households served (average household size)	8 (5)	45 (4)	50 (4)	120 (5)	55 (4)
Approximate Percentage population served	2%	14%	15%	24%	n/a

[1] Data supplied by NGO
[2] Estimate based on similar areas

Table 1: Pilot schemes indicating kiosk sales and households served (Bidii Yeti and High Ridge omitted)

	Jasho Letu	Heshima	TOP1	Obunga	Bandani
Delivery Method	Single hosepipe to houses supplied with tank – houses owned by management	Multiple pipes from meter bank	Multiple pipes from meter bank	2 no pipes from separate chambers – 1 privately owned, 1 group managed	Single 100m hosepipe
Approximate number of households served (average household size)	8 (5)	45 (4)	50 (4)	120 (5)	55 (5)
Average monthly rent per household	700Kes	1100Kes	1300Kes	1100Kes	1200Kes
Daily average number of jerrycans per household prior to application, and cost	6, 30Kes	4, 12Kes	4, 12Kes	6, 24Kes	5, 10Kes
Average no of jerrycans still purchased via collect and carry at the kiosk	n/a	1.9	1.3	<1	1.7
Daily average total number of jerrycans purchased following application	n/a	5.9	4.9	n/a (a delivery system has operated for some time)	5.7
Per capita usage increase (l/per person per day)	n/a	9.5	4.5	n/a	2.8
Perception of time saved due to delivery as indicated by consumers	n/a	5mins – 3hrs	5mins – 3hrs	5mins – 3hrs	10mins – 2hrs

Table 2: Pilot schemes showing change in household purchases (Bidii Yeti and High Ridge omitted)

Cost to consumers

The cost of water in the informal settlements where these innovations were piloted is extremely high, in some cases households paying more per month for water than for household rent. Table 4 highlights the price paid for water by consumers compared to the municipal utilities' bulk price in Mukuru and Kisumu. Consumers pay as much as 11 times the lowest utility tariff.

In order for the facilities and kiosks used in the pilot schemes to provide the different service levels, particularly the delivery option, they must charge an additional cost above the standard bulk rate in order to be able to employ an operator to run the service and keep adequate records. It proved difficult to reduce the prevailing cost for the standard collect and carry mode of water access, and it was felt that it was unfair to increase the already high prices for a delivery service to consumers who may be struggling with irregular and limited incomes and who are already paying significantly more for a poorer service than those supplied with individual connections.

	Mukuru, Nairobi		**Kisumu**	
Project	Heshima	TOP1	Obunga	Bandani
Price as sold by utility	19 Kes/m^3	19 Kes/m^3	25 Kes/m^3	35 Kes/m^3
Price sold by DMM	----	-----	35 Kes/m^3	-------
Cost to Consumer @ 45jerricans/m^3	135Kes	225Kes	160Kes	70Kes collected 105Kes delivered
Cost of jerrycan	3Kes Collected 3Kes Delivered	5Kes Collected 5Kes Delivered	3Kes collected (other taps) 4Kes Delivered	2Kes Collected 3Kes Delivered

Table 3: Cost of water to consumers in informal settlements

It is the water utility's access to increased economies of scale that can reduce the cost of water to those living in the informal settlements through the ability to cross subsidise. Though the differentiation in the level of service and where

possible the differentiation in price has been met with an overall positive reaction and some success in these projects, these innovative kiosk-to-household delivery methods with a corresponding difference in price and purchase options from the standard collection mode should be viewed as a transitional phase in utilities' overall ultimate goal of providing individual connections to all households (recognising the possibility of utilities themselves offering a range of services and prices during this transition).

Consumer reaction

The overall response of consumers to the delivery innovations was extremely positive, evidenced by a strong desire for the service to continue. The main advantages to residents was the saving in energy and time, the majority claiming to use this additional time for recreational, domestic and commercial activities. Not having to lock houses or carry children to water points were also cited as benefits. A majority of respondents indicated that, though they purchased more water when the delivery service was operational, they also still purchased a small number (1-3 on average) at the water kiosk. Households with in-house storage tanks or a significant number of jerrycans or buckets also benefited to a greater degree, managing to avoid any collect and carry journeys, and some residents indicated they intended to increase their storage capacity.

The aspirational design aspect of the Water Choices Kiosks experiment, anticipated to increase consumer acceptance and demand for improved water supply, was to be undertaken by a complementary research element of the project. Reported on separately (Mercer, A, 2012), the detailed 'cultural probes' and 'consumer aspiration questionnaires' undertaken in three of the research locations did not result in any buildable designs.

A second feature of the aspirational approach to water supply inherent in the Water Choices model is a variation in price. Prescribing a difference in price for a corresponding difference in service level proved extremely difficult, and was only achieved in one instance (Bandani in Kisumu), though it is hoped that as the various projects proceed it may be possible to introduce this difference in

price. Vested interests, such as the ‘cartel’ of water vendors in Kibera, make it particularly challenging in offering a reduced price for the standard mode of water collection. Also, where water vendors sit on the management committee of the bio-centres (Jasho Letu and Obunga), any attempt to reduce price is met with a negative and obstructive response. Attempting to change the pricing status-quo at facilities that already sold water (i.e. Mukuru) also proved difficult, with managers unwilling to reduce the price for collection in case of reduced revenues, though it is hoped as the delivery service develops and improves, and sales increase, this may be possible. Equally, when asked if they thought a reduced price for collection should be introduced, many respondents suggested it remain the same, fearing a price increase.

The researcher found that it was easiest to introduce the variation in price at the facility that did not already have a water connection, the Bandani bio-centre in Kisumu (it is hoped that this will also be introduced at the facility in Korogocho). The response to the difference in price for delivery and collect-and-carry ranged from those that never carried and were happy to wait until the delivery service arrived, to those who carried always in an effort to save money. In between, residents sometimes carried jerrycans ‘when funds are low’ or when they were unwilling to wait, or simply for a conversation: ‘I can talk to the lady (bio-centre caretaker)’.

Operators & Training

The operators of the delivery services hired by the bio-centre’s required training in the operation of equipment, connection of reels to meters and particularly in the reading of meters and record keeping in order to calculate daily water sales and corresponding calculations to ensure meter readings matched overall sales. Operators resided in the surrounding areas. In some cases, price lists were developed to ensure both operators and customers were able to understand the costs involved, particularly for volumetric purchases (see Appendix C). Calculators on mobile phones proved invaluable in assisting operators in ascertaining overall daily sales. All water delivery was done via meters, in the kiosks or meter banks, to ensure transparency and so the facility managers

could keep track of overall sales ensuring no water or cash was stolen. Most operators did not work on Sundays as they attended church. Operators were paid varying amounts by managers, in some cases extremely low, such as 50Kes/day (USD$0.48), though managers were encouraged to increase wages as revenues increased in order to create an incentive for operators to increase sales and coverage.

Technical information and materials

With the exception of 4 hose-reels imported from the UK, all materials and equipment were purchased and manufactured locally, ensuring that all apparatus can be replaced and repaired by local shops, welders and producers. Though the imported hose-reels were relatively expensive to introduce, they proved invaluable in allowing local welders to duplicate the technology in a simpler manner. Local welders and plumbers were also used to fabricate and equip meter boxes. In general, ½ inch flexible hosepipe was used to deliver water, mainly due to weight as using a larger size pipe (despite this being requested by customers and sometimes operators) makes moving the pipe from house to house more difficult and cumbersome, reducing the effective length and slowing the service.

The primary issue in developing the flexible hose-pipe delivery technique is water pressure. Weak mains pressure means that it is not possible to connect multiple hosepipes directly to the mains, requiring the use of large storage tanks located at roof level. For multiple delivery services such as those in Mukuru (where mains pressure is variable), the storage tank needs to be close to full capacity to allow multiple meters to be used at the same time, and in some instances only one or two hose-reels could be used due to an insufficient water level. Conversely, at the Bandani kiosk the plumbing was set-up in such a way that, when the mains pressure was high, the single hosepipe could be connected directly to the mains, or swopped to the storage tank when the mains pressure was low.

Additional comments and suggestions from customers

The most common request among customers was a request for more and longer or bigger delivery pipes to increase area coverage and the amount of time one could access water, as respondents believed this would potentially remove the requirement for any trips to the water kiosk, and would allow water to be accessed throughout the day. An additional suggestion was that water could be treated at the source prior to delivery. Suggestions for water on credit and a bonus system (buy 5 jerrycans, get 1 free) were also made.

The positive effect on the elderly, the young, the sick, disabled and those who struggled to fetch water (for example, pregnant women) was noted, as well as a reduction in falls and accidents while carrying jerrycans, particularly during the rainy season (though, when it did begin the rain, the service would cease). Those who generally paid others to bring jerrycans to their homes were particularly grateful, also due to the fact that they were now sure what source the water was coming from.

Some respondents, mostly in Kisumu, complained that to fill in-house storage tanks, the vendor had to enter the house (unless the tank was by the door) to fill, which they felt invaded their privacy, and complained if the vendor was dirty.

Difficulties in application

It took considerable time to construct the necessary buildings, repairs of existing structures and manufacture the required apparatus. Some elements such as hose-reels needed to be fabricated by local manufacturers. Additionally, explaining the Water Choices concept proved difficult, management uptake was slower than anticipated and implementing the delivery service took a significant amount of time. Table 4 outlines briefly the length of time it took to begin the pilots, the amount of time they have been running and the difficulties and challenges in implementation.

	Bidii Yeti, Kibera	Jasho Letu, Kibera	Heshima, Mukuru	TOP1, Mukuru	High Ridge, Korogocho	Obunga, Kisumu	Bandani, Kisumu
Time to implement project	12 months, ongoing	Partially implemented	3-4 months	3-4 months	6 months, Ongoing	3-5 months	3-6 months
Length of time project has been running	n/a	3 months	2 months	1 month	n/a	2 months	4 months
Delays and difficulties	Water cartels, vested interests, management issues, lack of water	Corruption, vested interests, increase in local competition, water cartels, water vendors in management committee	Poor pressure resulting in no water, difficulties in construction, poor access, broken pipes, theft	Poor pressure resulting in no water, broken pipes, implementing delivery service, tenancy problems	Permission for original site rescinded, Slow construction	Permission for original site rescinded, requirement for new connection, leaks, pipe replacement, vested interests, management issues	Management issues, requirement for new connection, unpaid bills, disconnection, difficulty in implementing delivery service

Table 4: Difficulties, challenges and delays in implementing pilot schemes

7 Conclusion

This research has found that applying simple, locally made and manufactured technologies, designed to suit the prevailing area and its residents, can enhance access to water in informal settlements, and that residents reacted positively to these innovations, wishing them to continue and also offering suggestions for developing and enhancing of the improved access. The application of innovative distribution approaches, and their operation by local community groups and hired operators, freed up much time and energy (among other benefits), allowing consumers to spend extra time on domestic, commercial and recreational activities. It also showed residents may be willing to work together to enable each other to gain access to this improved service.

The research showed that consumers reacted positively to the offer of a choice in service level with a corresponding variation in price when accessing water and were willing move from one service to the other depending on daily income levels, when the more convenient service was available, or simply through a matter of choice. In-house storage was also identified as a key factor in allowing residents to move from one service level to the other.

The difficulty in applying this variation in service and price levels when confronted with vested interests intent on maintaining their monopolies and the high prices for water regularly encountered in informal settlements was also highlighted, and contributed to delays in implementation. The challenges in implementing alternative designs to challenge the status quo, and advancing new technologies in informal settlements were emphasised. However when it was possible to initiate these improved services, they were successful evidenced by increased sales at water points and increased purchases at the household level.

The original research plan was to introduce different delivery and pricing elements and innovations as the individual projects proceeded, as the researcher felt the concept was not fully clear to residents and operators. However, this only served to further entrench some of those unwilling to change

the status quo, and in hindsight it may have been more beneficial to simply design and deploy a full Water Choices kiosk subject to initial surveys and interviews rather than trying to gradually introduce subject to users acceptance and retrofit to existing kiosks.

Given the positive impact of these innovations as reported by consumers and evidenced by increased sales at kiosks and purchases at households, alternative suppliers, NGO's and particularly utilities could use similar or more advanced delivery technologies to extend coverage 'the final 50m' from kiosks and tapstands to households to give consumers access to the health and convenience benefits associated with households connections, while the necessary improvements in utilities' performance are made. These innovations should be seen as a step towards universal coverage and are as such part of a transition phase towards the ultimate goal of household connections for all. Also, utilities access to greater economies of scale will enable the price for consumers in slums to be reduced, enabling the difference in price as experienced in Bandani to be introduced.

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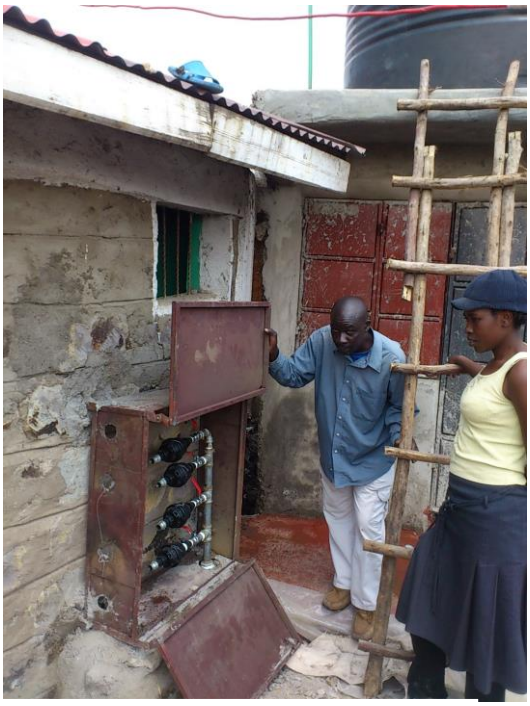
APPENDIX A – Additional Photographs

Heshima, Mukuru

Hose-reels used from Heshima Meter box



Meter box from Heshima

Filling an external storage tank, Heshima

Resident filling jerrycans, Heshima

TOP1, Mukuru

Using Hose-reel, TOP1

Meter bank with pipes connected

Obunga, Kisumu

Locally made reel and wheelbarrow with chamber in background, Obunga

Filling with handheld water meter, Obunga

Filling in house storage tank, Obunga

Bandani, Kisumu

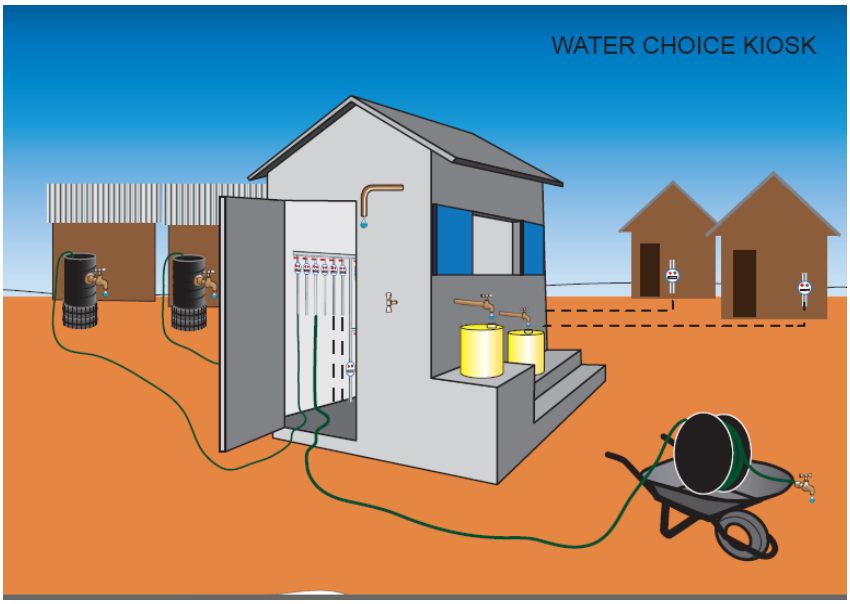
Operator selling at house, Bandani

Operator sells to houses in distance, Bandani

Customer carrying from kiosk, Bandani

APPENDIX B – Additional Water Choices Concepts and Designs

Original Water Choices concept – collect, delivery via hosepipe, volumetric delivery via hosepipe, no fixed assets (Dr Richard Franceys, 2009)



Original Water Choices Kiosk concept – collect, delivery via flexible hosepipe with volumetric or prepaid options (Alex Mercer, 2011)

Water Choices Kiosk, Yaounde, Cameroon – collect, delivery via hosepipe, metered underground connections (Benjamin Pallier, 2012)

APPENDIX C – Sample Questionnaires

Initial baseline questionnaire

1. Are you the respondent male/female?.....
2. Are you the respondent the head of the household?.....
3. How many people live in the household, including children?.....
4. How much is monthly rent?.....or are you the owner?.....
5. What is the daily water usage of the household (cost/no of jerrycans)?.....
6. Where do you normally purchase water?.....Why do you use this kiosk/tapstand/etc……
7. What times of the day do you normally buy water?.....
8. Is this source convenient? (can you access when you want)? Is there a long waiting time? ..... Why is it (in) convenient)?.....
9. Do you collect and carry your water home or have it delivered?.....Who in the household carries water? Children?.....
10. How much total time do you estimate you spend accessing your households' daily water requirements every day?.....How many times do you go to the kiosk/water point per day?.....
11. How much do you pay per jerrycan (or alternative) during
    a. Normal Service?.....
    b. Water shortages?.....
12. Do you think you pay too much for water?.....If yes, what do you think is a fair price?.....
13. Would you pay extra to have water delivered to your house? How much?.....

14. How do you rate the water quality from this source? Good (clear, good taste) or bad (cloudy, bad taste)?.....
15. Do you treat the water in your home?.....How do you treat it (waterguard, boiling etc)?.....why do you treat your water?.....
16. Do you have a storage tank in your house?.. …...What size?.....How do you use this tank? Do you fill and use the water in the tank daily?.....or do you just use it for shortages?.....If you don't have a storage tank, what size would you like to have?.....Where would you put it?....
17. What most concerns you when you purchase water? Cost, time involved, quality, other? .....
18. What other factors must you take in to account when accessing water? i.e. do you have children to look after? Must you lock your house? Do you have a business/job? Is it more difficult during bad weather? What other difficulties do you face when buying water? .....
19. Would you like an option of
    a. Having water delivered to your home while you're not there?.....
    b. Being able to purchase water at the kiosk when the owner is absent?
    c. How do you think this would affect your daily routine?.....
20. What changes in service would you like to see to enable to improve your ability to access and pay for water? (rank them)
    a. In house Storage
    b. Cheaper price
    c. Deliver to door (when absent)
    d. Purchase when wanted (i.e. no queuing or relying on vendor)
    e. Guarantee of quality

Follow up questionnaire

1. Have you received water via the delivery hosepipe from the kiosk?.....
2. Do you purchase more water when the pipe comes to the door?..... If so, how many extra jerrycans do you buy per day?....
3. Do you have a storage tank?.....Do you fill this tank with the pipe?.....How do you find this part of the service?.....
4. Do you still fill jerrycans at the kiosk/tapstand and carry back to your house?.....How many times a day?.....Is this less than you would normally, i.e. before the hosepipe service……
5. Do you carry less jerrycans from the kiosk because of the hosepipe delivering water?.....Do you know how many less? .....How much time do you save per day when the water is delivered and you don't have to collect?.....
6. Do you find the delivery service convenient?.....could you give an example of when it is not convenient?.....
7. And also give some suggestions how you think the service could be improved?.....
8. Do you think it would be fair or a good idea if there was a difference in price between the delivery option and the normal service when you carry yourself, i.e. maybe 1 Kes less for the self-service? .....
9. Do you still treat the water that comes through the hosepipe?.....
10. Other comments: i.e. effect on children, what do people spend the spare time doing, any extra stories.....

APPENDIX D – Sample price lists

Bandani Water Choices Price List – hosepipe

7L = 1Kes

14L = 2Kes

21L = 3Kes (1 Jerrycan)

28L = 4Kes

35L = 5Kes

42L = 6Kes

49L = 7Kes

56L = 8Kes

63L = 9Kes

70L = 10Kes

77L = 11Kes

84L = 12Kes

91L = 13Kes

100L storage tank = 14Kes

150L storage tank = 21Kes

200L storage tank = 28Kes

210L storage tank = 30Kes

Obunga Water Choices Price List – hosepipe

5L = 1Kes

10L = 2Kes

15L = 3Kes (1 Jerrycan)

20L = 4Kes

25L = 5Kes

30L = 6Kes

35L = 7Kes

40L = 8Kes

45L = 9Kes

50L = 10Kes

60L = 12Kes

90L = 14Kes

80L = 16Kes

100L storage tank = 20Kes

150L storage tank = 30Kes

200L storage tank = 40Kes

210L storage tank = 42Kes